National Aeronautics and
Space Administration

Algorithm Development for a Many-Core HPC Landscape

Large-scale fluids simulations are routinely used to determine the viability and performance of new vehicle concepts for numerous space, aeronautics, and science missions at NASA. Practical computations of complex flow phenomena using tools such as NASA Langley's FUN3D solver require efficient use of leadership-class high performance computing systems. The new generation of many-core HPC architectures presents tremendous challenges for software developers—applications are likely to perform worse if not refactored for new hardware paradigms. The goal of our effort is to identify key programming strategies to achieve optimal performance on Intel Xeon Phi Knights Landing (KNL) processors and NVIDIA Pascal and Volta GPUs.

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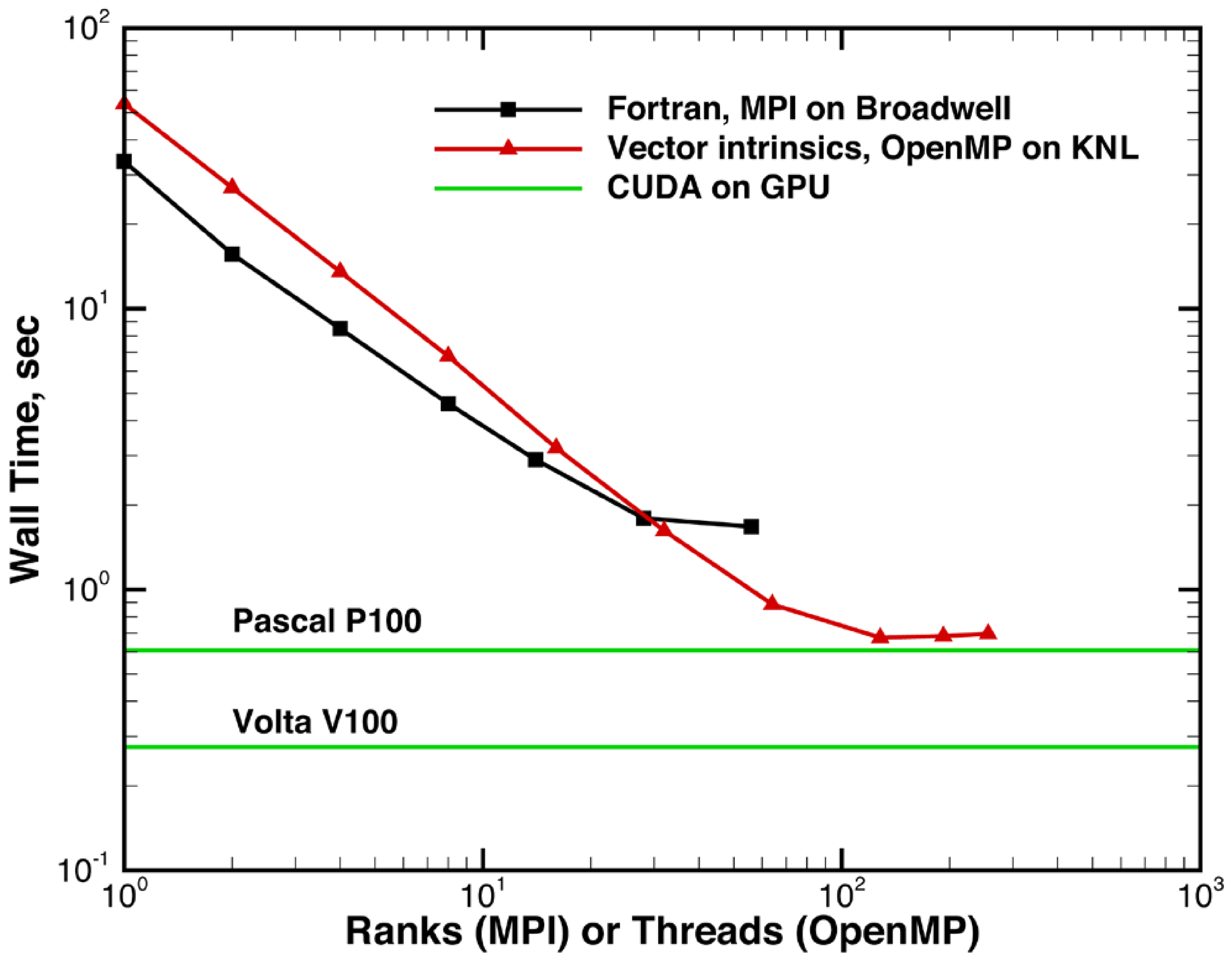

Performance of the multicolor, point-implicit, linear solver used by NASA's FUN3D fluid dynamics solver on the Pleiades supercomputer's Intel Xeon (Broadwell) and Xeon Phi (KNL) processors, and NVIDIA GPUs. Different programming models are used for each; the many-core architectures show a considerable speedup over the baseline Xeon hardware. *Aaron Walden, NASA/Langley, Mohammad Zubair, Old Dominion University*